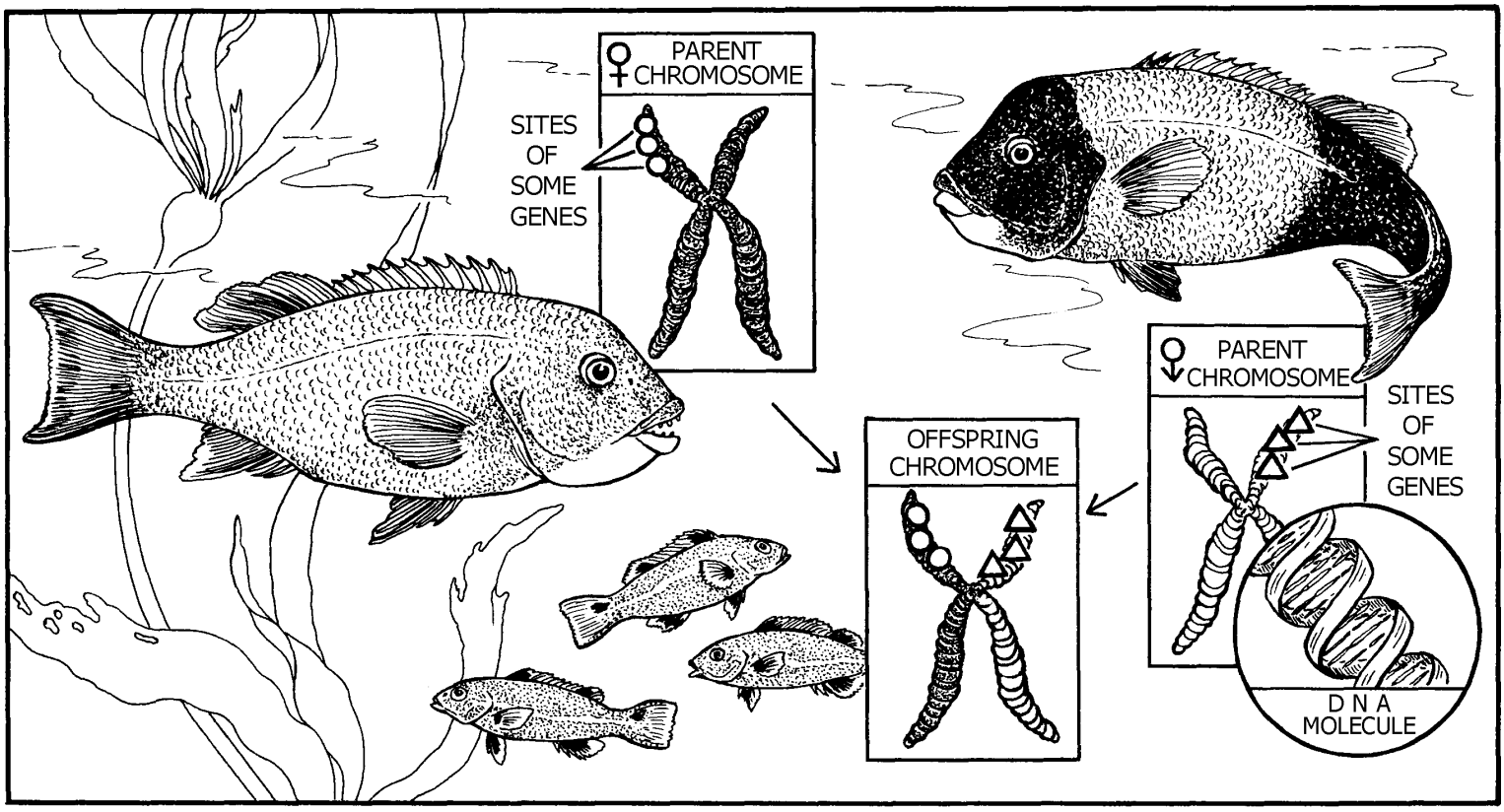


GENES ARE INHERITED (CALIFORNIA SHEEPHEAD SHOWN)

Genes in Marine Habitats

What do you suppose causes such incredible variety in marine animals? You don't have to look very far to begin finding an answer to this question. Think about your own family or other families you know. Can you discover a resemblance among family members such as similar facial features, height, and hair or eye color? Just as with human beings, many marine animals are the result of sexual reproduction involving two parents. As a result, the offspring of a marine species has physical features similar to its own parents.

Each member of a new generation inherits genes from the previous generation. Long DNA molecules hold all the coded information for making an animal's body design. This basic genetic material also provides working instructions to cells. The DNA is located in the chromosomes of each cell, and many genes are incorporated into its structure. One or more of these genes can determine inherited traits for a species of fish such as fin shape, coloration or patterning. The offspring from two parents inherit half of their genes from each parent. For instance, inherited traits tell whether the individual will develop features of an adult California sheephead.

Sheephead fish are a keystone species in the kelp forest ecosystem. Where they are found in large numbers it is evidence of a healthy marine ecosystem that supports a good variety of species. Interestingly, all sheephead are born female. It is the presence of adult males, or lack thereof, that stimulates young fish to remain female or to develop the features of the more colorful adult male. Adult males have a black head (with a prominent, fleshy bump on their forehead), a black tail, and a band of red in the midsection. Females are pink or reddish.

Even within a single population there can be great differences in the genes carried by individuals of the same species. There are slight differences in traits from individual to individual. The total pool of genes carried by all individuals in the entire population of a species is known as its gene pool. A diverse gene pool is believed to benefit the survival of a species. Why is this? Individuals especially well adapted to a specific habitat are the ones most likely to survive there. Perhaps, they have a mouth shape that allows them to better feed on the local resources. They may display better camouflage or have other ways to escape their predators. As a result

of having a way to survive, they will be the ones likely to pass on their unique set of genes. The individuals that lack genes for the most successful traits are less likely to reproduce at all. Eventually, genes for traits that are less fit for the environment may disappear from the gene pool altogether.

Natural Selection

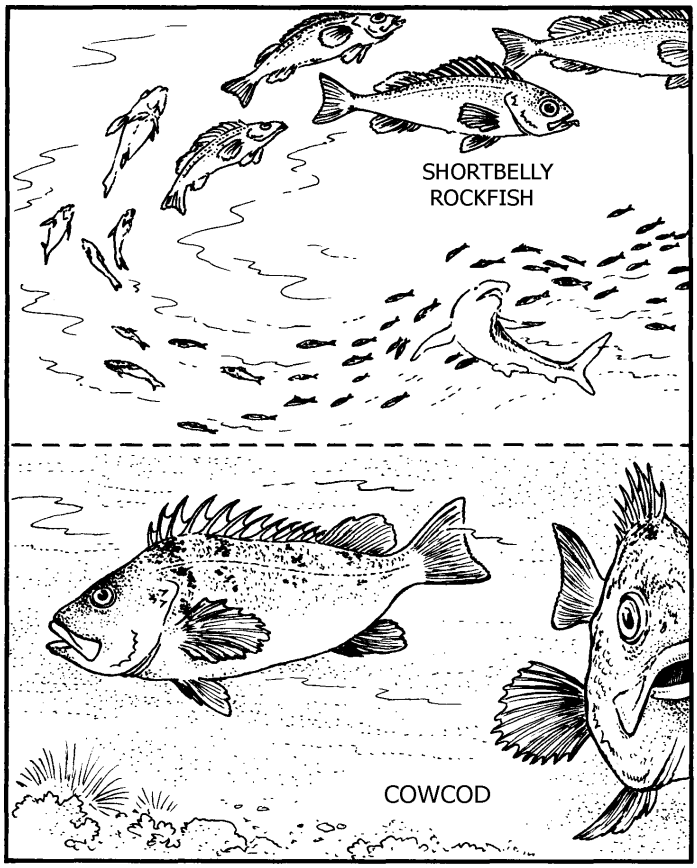
Charles Darwin in 1859 was the first to theorize that a process of natural selection drives biological evolution. He observed that nature appears to select the fittest individuals, favoring those with the traits that are best adapted for survival. He reasoned that selected traits would appear more frequently in a population over time. He also considered that a population of a single species could become split into two groups, with one group separated from the other by distance or some other barrier. If this happened then each population could evolve differently. Without being able to interbreed, the two populations would adapt separately to two different habitats. This process may account for the diversity of species we find in marine ecosystems.

Let's consider two species of rockfish that display very different physical adaptations. The tiny shortbelly rockfish grows to 8 – 10 inches in length. Each fish weighs only a fraction of a pound. A mature cowcod, on the other hand, can weigh more than 20 pounds. Amazing as it seems, these two species are very closely related as verified by tests of their DNA. How could such differences have come about?

Changes in the physical features of a species are thought to take place through a gradual process of adapting to the environment over many generations. Shortbellies are found at depths of up to 900 feet where they move together in a display of schooling behavior. The conditions at this depth include many larger predators. It has been demonstrated that the inherited ability to school together provides an effective defense by confusing predators. It also selects those fish that show strong schooling behaviors for survival. The deep dwelling cowcod lives between 300 and 1200 feet below the surface. In the lower depths is found a habitat of little light but it is under great pressure from all the water up above pressing down. The cowcod has adapted larger body structures that tolerate the pressure. Few people know that cowcod are slow growing and can live to over sixty years of age. Their recruitment rate, however, (the speed at which they can produce young to replace older fish) is extremely low. As a result, this species is highly vulnerable to over-harvesting by people.

The solitary cowcod is also not a schooling rockfish. There is little advantage in having that genetic trait here. The predators for which schooling behavior would be a good defense are less commonplace in the dark coastal slope habitat. The larger cowcod has even become predator to many others, including shortbelly rockfish.

As different as they appear to be, DNA evidence suggests that shortbelly and cowcod likely shared a common ancestor. But once two populations became isolated from one another and were unable to interbreed then each separate group began the process of adapting to different conditions and developing their own unique gene pool. Today, they are two distinct species. In the coastal waters of California there are over 60 species of rockfish adapted to fill many habitats and niches.



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